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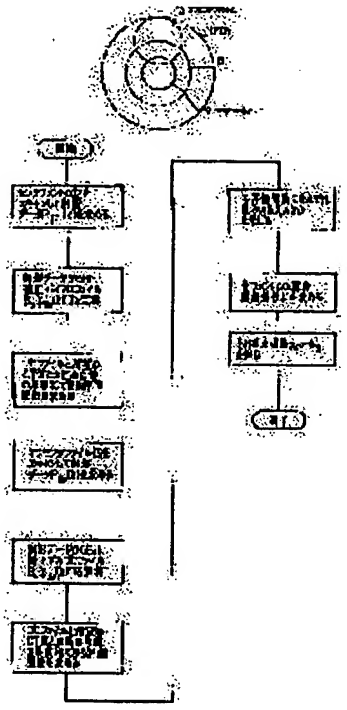
(54) BEAM HARDENING CORRECTING METHOD

(57)Abstract:

PURPOSE: To improve uniformity in the CT values of off-center phantoms by calculating an evaluation function by respectively scanning respective center phantoms and the off-center phantom, adding the respective evaluation functions while applying weight, and obtaining a BH correcting coefficient by calculating the evaluation function obtd. by integrating all the phantoms.

CONSTITUTION: By adding a sum δ of error as the evaluation function obtained by scanning a center phantom 12 and the evaluation function obtained by scanning an off-center phantom 13 while multiplying a weight w(k) by the evaluation functions of the respective phantoms, an evaluation function δ, obtd. by integrating all the phantoms 12 and 13 is calculated and BH correction coefficients b0-b8 are calculated. Thus, in the case of BH correction executed by using the phantoms, even when the off-centered water phantom is used, the uniformity in the CT values of the off-center phantoms can be improved while being balanced with the uniformity in the center water phantom.



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[Date of extinction of right]	

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] About the amendment beam (hardening BH) amendment method, especially, this invention continues throughout a reconstruction picture field, and relates distortion produced according to the beam hardening effect generated in X-ray CT to the amendment BH amendment method on the average.
[0002]
[Description of the Prior Art] X-ray CT is equipment which detects with a detector the X-ray which was emitted from the X-ray tube and penetrated the analyte, and obtains a tomogram. The X-ray spectrum has large attenuation of a low energy portion, therefore the portion of a high energy becomes large relatively, hardening is common knowledge and this phenomenon is known as a BH effect as an X-ray penetrates an inspected object and decreases, since the X-ray used for this CT is usually a multicolor X-ray. Projection data become nonlinear according to this BH effect. Change of the projection data based on this BH effect is shown in drawing 6 . In drawing, they are a curve in the ideal state where 1 is not influenced by the BH effect, and the curve which 2 passed through the organization of an analyte and has been influenced of the BH effect. Thus, if it passes through the organization of an analyte, the projection data will become nonlinear in response to distortion according to the BH effect.
[0003] Conventionally, nonlinear amendment by this BH effect was performed using the water phantom. Generally, derivation of BH correction factor performed using a water phantom is performed by making into the minimum the sum of the error shown below. The sum delta with error is called for by (1) formula.
[0004]
[Equation 1]

$$\delta=\sum_{k=1}^{n}\int_{g_k}^{h_k}\{I(s)-c_k\}^2 ds \qquad \cdots(1)$$

[0005] However, I (s): Image s of the reconfigurated water phantom : Pixel ck : CT valve of the phantom to flatten (constant). k subtracted ck (in the case of a water phantom, it is 0) which is the CT valve of the aforementioned water phantom to flatten from image I (s) which carried out data picture reconstruction according [the number (1) formula of a phantom] to a water phantom -- namely, ck from -- it is the formula which asks for the sum delta of the error value which squared the deviation and accumulated about all n water phantoms This delta is used as a performance index of BH amendment.
[0006] Since it means that making the sum delta of this error into the minimum had performed BH amendment, it asks by carrying out the partial differential of the minimum value of delta by BH correction factor, as shown in (2) formulas.
[0007]
[Equation 2]

$$\frac{\partial \delta}{\partial b_m} = 0 \qquad \cdots(2)$$

[0008] Here, it is bm. BH correction factor and m are the number of 0-8. In order to perform BH amendment, it asks for projection data Pij' amended by performing an operation like the following formula.

[0009]

Pij'=B0 i-Pij+B1 i-Pij2+B-2i-Pij3 ..... (3)

Here, it is projection data (the data of all channels are taken for every view) of an Pij:i channel j view. BH correction-factor file B0i, B1i, and B-2i which are the coefficient of the projection data of B0 file [i, B1i, and B-2i:BH correction-factor] (3) formula are called for by solving the following simultaneous equations.

[0010]

[Equation 3]

$$\left.\begin{aligned} B_{0i} &= b_0 + b_3 Q_i + b_6 Q_i^2 \\ B_{1i} &= b_1 + b_4 Q_i + b_7 Q_i^2 \\ B_{2i} &= b_2 + b_5 Q_i + b_8 Q_i^2 \end{aligned}\right\} \qquad \cdots(4)$$

[0011] Here, it is Qi. : Path length b0 -b8 of a bow tie filter : BH correction-factor b0 -b8 of BH ********** BH amendment can be performed by asking.

[0012] If picture reconstruction is carried out from the projection data Pij of a certain phantom k (k) and the value of the picture profile in Pixel s is set to Bs (Pij (k) '), the following formula will be obtained with the linearity of picture reconstruction.

[0013]

[Equation 4]

$$B_s(P_{ij}(k)') = b_0 + f_{0k} + \sum_{m=0}^{8} b_m f_{mk} \qquad \cdots(5)$$

[0014] (5) Bs (Pij (k) ') of a formula is equivalent to I (s) of (1) formula. Thus, the sum delta of the error value of n phantoms which evaluate a difference with the CT valve which wants to press [CT valve] down the value and cupping of a profile for which it asked, and to flatten them in the range of [gk and hk] is called for by the following formula.

[0015]

[Equation 5]

$$\delta = \sum_{k=1}^{n} \int_{g_k}^{h_k} \{B_s(P_{ij}(k)) - c_k\}^2 ds \qquad \cdots(6)$$

[0016] Here, it is ck. The partial differential of the sum delta of the error of CT-valve ** made into the target of Phantom k is carried out by (7) formulas, and simultaneous equations are obtained.

[0017]

[Equation 6]

$$\frac{\partial \delta}{\partial b_m} = 0 \ (m=0\sim 8) \qquad \cdots(7)$$

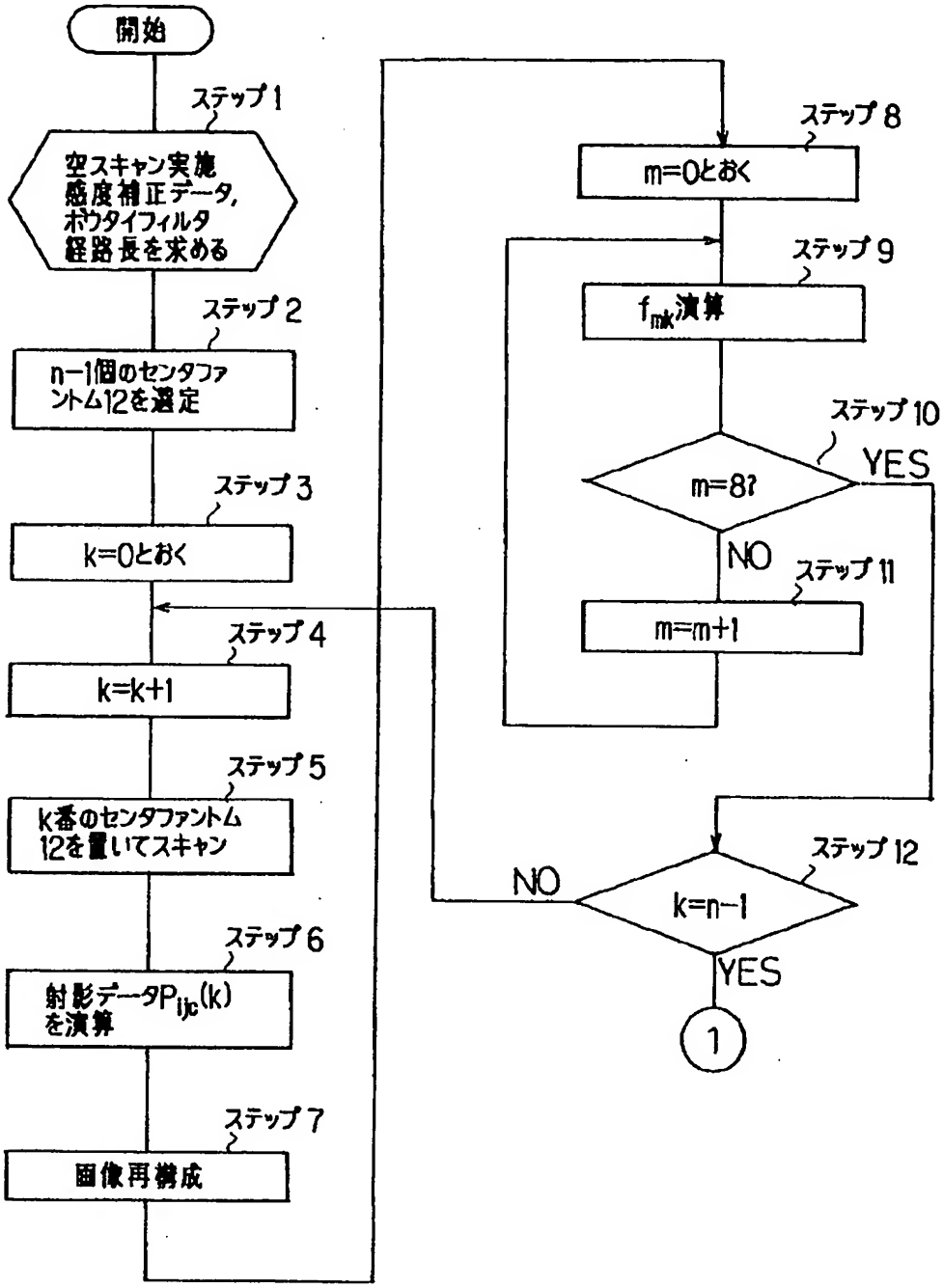
[0018] (7) Solve the simultaneous equations obtained from the formula and it is bm. It asks. Here, fmk of (5) formulas is a value shown in (8) formulas, respectively.

[0019]
[Equation 7]

$$\left.\begin{aligned} f_{0k} &= Bs(P_{ij}(k)) \\ f_{1k} &= Bs(P_{ij}(k)^2) \\ f_{2k} &= Bs(P_{ij}(k)^3) \\ f_{3k} &= Bs(Q_i P_{ij}(k)) \\ f_{4k} &= Bs(Q_i P_{ij}(k)^2) \\ f_{5k} &= Bs(Q_i P_{ij}(k)^3) \\ f_{6k} &= Bs(Q_i^2 P_{ij}(k)) \\ f_{7k} &= Bs(Q_i^2 P_{ij}(k)^2) \\ f_{8k} &= Bs(Q_i^2 P_{ij}(k)^3) \end{aligned}\right\} \quad \cdots(8)$$

[0020]
[Problem(s) to be Solved by the Invention] The uniform phantom from which the size by which centering was usually carried out in this phantom k differs is used conventionally, and it is BH correction-factor b0 -b8. It was asking. That is, although it was asking for raising the homogeneity of the water phantom from which the size put on the center of a reconstruction picture field differs in derivation of BH correction factor as a performance index, the homogeneity of the water phantom by which the off center was carried out is bad, and there was a bird clapper.
[0021] this invention was made in view of the above-mentioned point, and the purpose is realizing BH correction method which can be raised while balancing the homogeneity of the water phantom which put the homogeneity of the CT valve of an off center phantom on the center, when it uses with the water phantom which put the water phantom by which the off center was carried out on the center.
[0022]
[Means for Solving the Problem] this invention which solves the aforementioned technical problem distortion by the BH effect produced in X-ray CT An amendment sake, In the BH amendment method of obtaining BH correction factor by the performance index which carried out the scan of the uniform center phantom by which centering was carried out, and obtained it The performance index which synthesized all phantoms by multiplying the performance index of each phantom by weight, and adding to it the performance index which carried out the scan of the aforementioned center phantom, and obtained it, and the performance index which carried out the scan of the uniform off center phantom by which the off center was carried out, and obtained it, respectively is searched for. It is characterized by obtaining BH correction factor.
[0023]
[Function]

Drawing selection drawing 1



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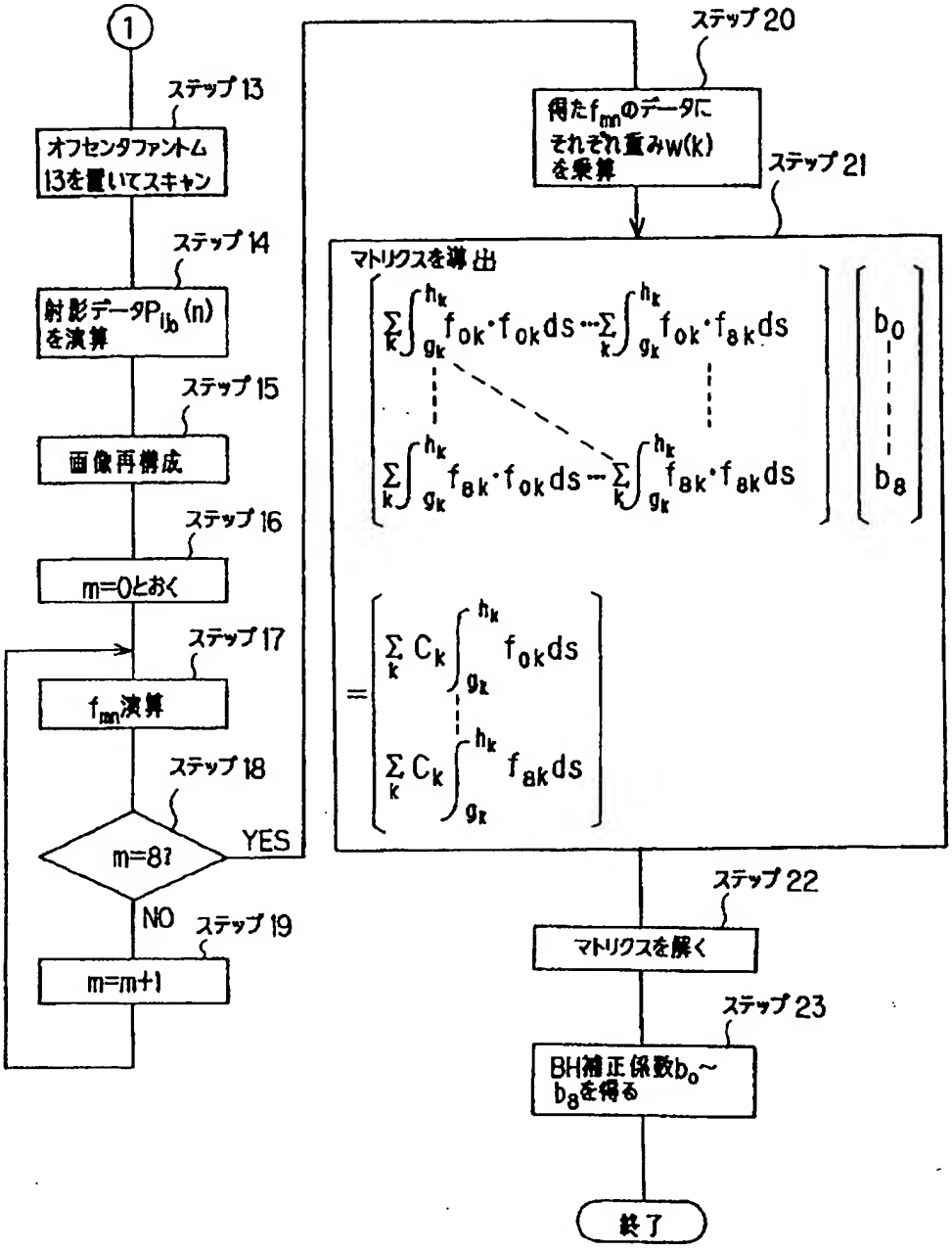

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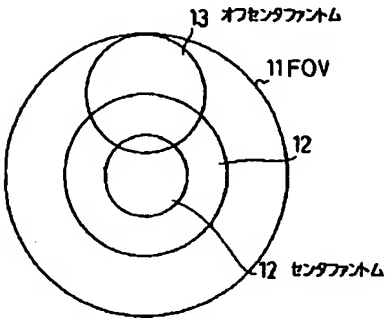

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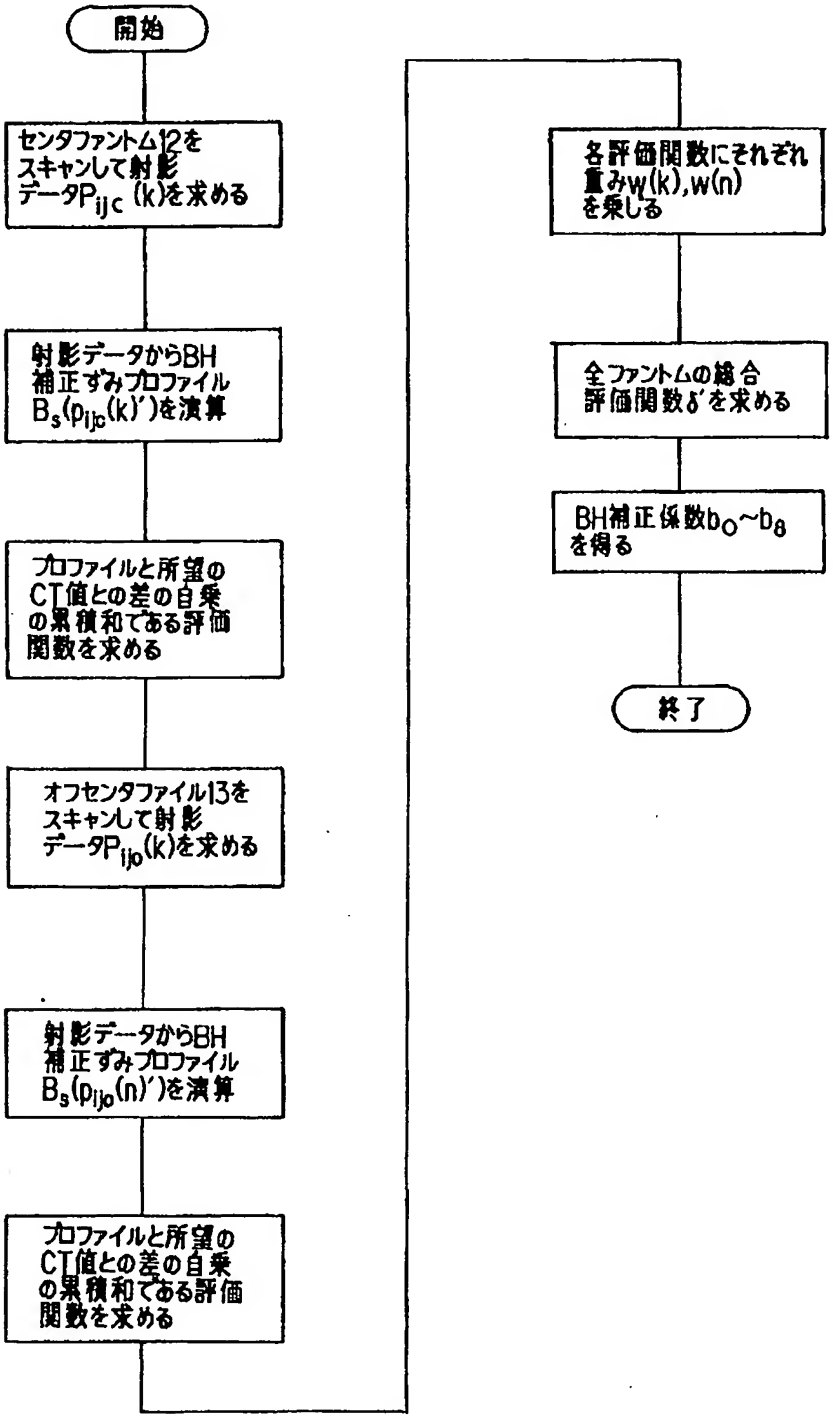

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Drawing selection drawing 5

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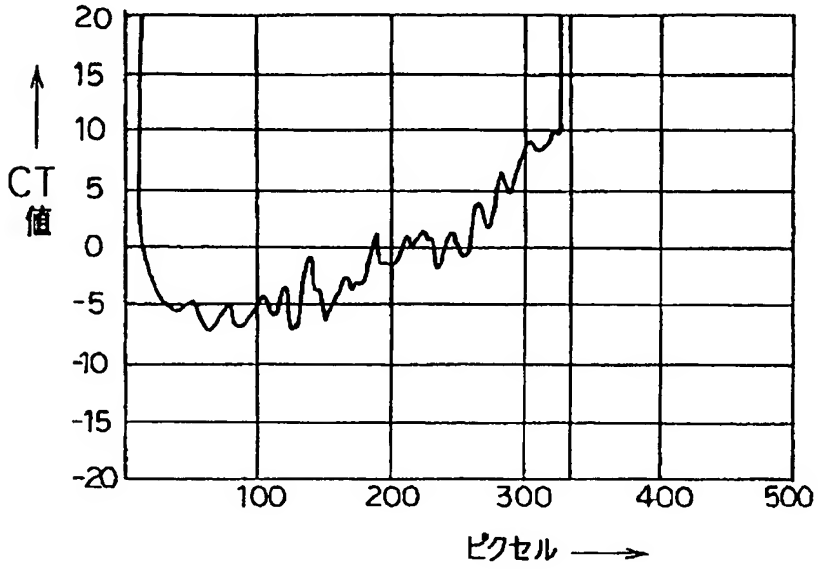

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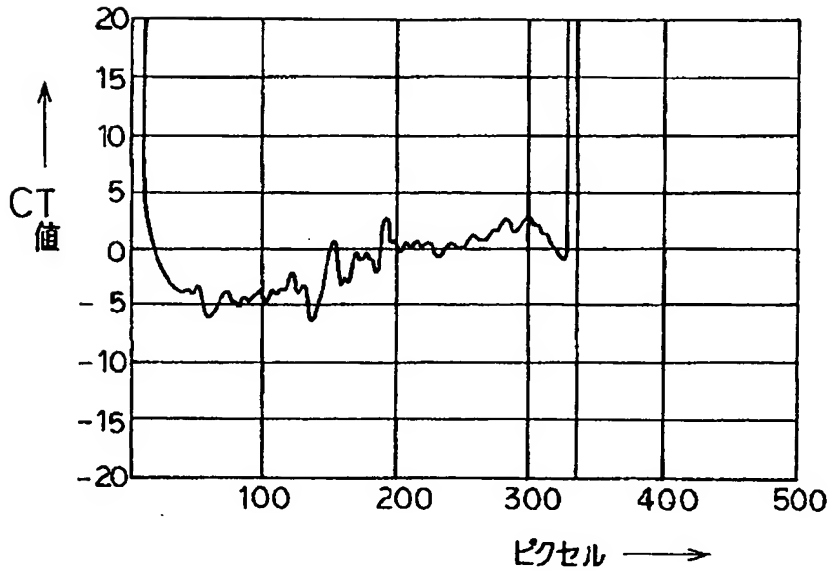

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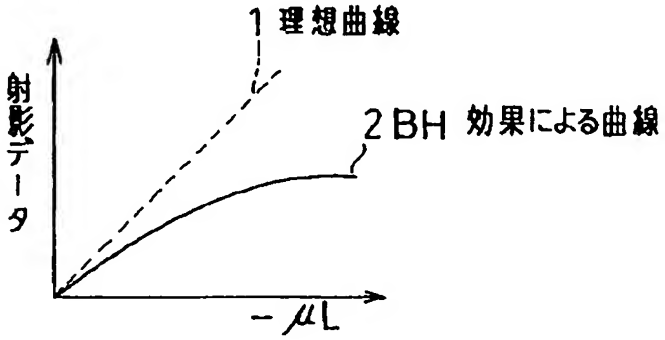
Drawing selection drawing 6



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